Adopted Levels, Gammas

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	Balraj Singh and Jun Chen	NDS 178,41 (2021).	12-Nov-2021

Q(β^-)=−1674.62 *21*; S(n)=9657.46 *20*; S(p)=12536 *19*; Q(α)=−8111 *3* 2021Wa16
S(2n)=16495.23 *21*, S(2p)=22798.9 *28* (2021Wa16).
Mass measurements: 2007Gu09, 2005Gu36, 2004He32, 1974De22.
Following reactions deal with cross sections or reaction mechanism:
^{66}Zn(^{14}C,^{16}O): 1981Be40 (72 MeV).
^{65}Cu(n,d), (n,np): 1987Ah01 (9,11 MeV), 1982Sh28 and 1979Sh25 (14.2 MeV), 1979Gr06 (14.8 MeV), 1967Ch02 (14 MeV), 1965Fa06 (14 MeV).
Additional information 1.
^{65}Cu(γ,p): 1971We06 (17 MeV), 1968Ab10 (≤26 MeV).
^{65}Cu(p,2p): 1977Sh03 and 1977ShZQ (17 MeV).
^{64}Ni(d,np): 1971Ne07 and 1970Ne16 (13.6 MeV), 1968Cu04 (<16 MeV).
^{64}Ni(π,Xγ) E=100, 160, 220 MeV: 1978Ja19. Measured prompt and β delayed spectra of residual nuclides.
^{64}Ni(π^-,γ): 1990Ku08.
Muonic atom: 1976Sh21.
Antiprotonic atom: 2001Tr23.
^{64}Ni(π,X): mesic atom: 1990Ku08.
^{64}Ni(t,t) E=20 MeV: 1969Fl06: Measured $\sigma(\theta)$.
^{64}Ni(a,dd): 1988Me14 (96 MeV).
^{65}Cu(n,d) E=6-16 MeV: 1997Di07: analysis of σ(E) data.
^{62}Ni(^{18}O,^{16}O): 1973Au02 (50,57,65 MeV).
Hyperfine structure, isotope shift measurement with optical method: 1980St21.
Consult NSR database for theory references on nuclear structure.
^{64}Zn can decay by double β decay to ^{64}Ni. Many measurements have been reported dealing with search for β transition to ^{64}Ni g.s.. No definitive decay has been observed, upper limits on ^{64}Zn half-life have been established. The latest reports are 2020Az05, 2011Be39, 2010Be41, 2009Be27, 2009Da16, 2008Be02, 2007Bl15, 2006Wi12, 2006Zu02. For details, see $T_{1/2}$ comment for g.s. of ^{64}Zn in Adopted Levels for ^{64}Zn.

^{64}Ni Levels

Cross Reference (XREF) Flags

A	^{64}Co β^- decay (0.30 s)	K	^{64}Ni(π,X):mesic atom	U	^{65}Cu(d,^{3}He)
B	^{64}Cu ε decay (12.7006 h)	L	^{64}Ni(n,n′)	V	^{65}Cu(t,α)
C	^{62}Ni(t,p)	M	^{64}Ni(n,n′γ)	W	^{67}Zn(n,α)
D	^{62}Ni(α,^{2}He)	N	^{64}Ni(p,p′)	X	^{68}Zn(d,^{6}Li)
E	^{62}Ni(^{12}C,^{10}C)	O	^{64}Ni(p,p′γ)	Y	^{208}Pb(^{64}Ni,^{64}Ni′γ)
F	^{62}Ni(^{18}O,^{16}Oγ)	P	^{64}Ni(d,d′),(pol d,d′)	Z	^{238}U(^{64}Ni,^{64}Ni′γ)
G	^{63}Ni(n,γ) E=th	Q	^{64}Ni(^{3}He,^{3}He′)	Others:	
H	^{63}Ni(n,γ):resonances	R	^{64}Ni(α,α′)	AA	^{238}U(^{70}Zn,Xγ)
I	^{64}Ni(e,e′)	S	^{64}Ni(α,α′γ)	AB	Coulomb excitation
J	^{64}Ni(π^+,π^+),(π^-,π^-)	T	^{64}Ni(x,x′):inelastic scatt	AC	Muonic atom

E(level)†	Jπ‡	$T_{1/2}$	XREF	Comments
0.0	0^+	stable	ABCD FG IJ LMNOPQRSTUVWXYZ	XREF: Others: AA, AB Evaluated rms charge radius <r^2>$^{1/2}$=3.8572 fm *23* (2013An02). Evaluated δ<r^2>(^{60}Ni,^{64}Ni)=+0.338 fm^2 *10* (2013An02). Measured δ<r^2>(^{60}Ni,^{64}Ni)=+0.368 fm^2 *9*; deduced total charge radius R_c(^{64}Ni)=3.854 fm *2* (2020Ka22). Measured isotope shift $\delta\nu$(^{60}Ni,^{64}Ni)=+1027.2 MHz *25*(stat)

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Adopted Levels, Gammas (continued)

^{64}Ni Levels (continued)

E(level)†	Jπ‡	$T_{1/2}$	XREF	Comments
				77(syst) (2020Ka22). Measured $\delta<r^2>(^{64}Ni,^{58}Ni)$=+0.6362 fm^2 *48*; $\delta<r^2>(^{64}Ni,^{60}Ni)$=+0.3631 fm^2 *48* (2021Ko18). Measured isotope shift $\delta\nu(^{64}Ni,^{58}Ni)$=+1534.3 MHz *26*, $\delta\nu(^{64}Ni,^{60}Ni)$=+1028.2 MHz *26* (2021Ko18).
1345.777 *23*	2+	1.086 ps *35*	ABCD FG IJ LMNOPQRSTUVWXYZ	XREF: Others: AA, AB μ=+0.37 *6* (2001Ke02,2001Ke08,2020StZV) Q=+0.35 *20* (1971ChZT,2016St14,2021StZZ) B(E2)↑=0.0705 *29* β_2=0.206 *21* (1989Va02) XREF: Q(1320). Jπ: L(t,p)=L(α,α')=L(d,d′)=L(p,p′)=2 from 0+. $T_{1/2}$: weighted average of 1.065 ps *116* from RDDS in $^{238}U(^{64}Ni,^{64}Ni'\gamma)$ (2017Kl01) and 1.088 ps *35* from DSAM in Coul. Ex. (2001Ke08,2001Ke02). Others: 0.017 ps *8* from DSAM in (n,n′γ) (1983El03, 1989Ge09); 0.28 ps *10* from DSAM in (α,$\alpha'\gamma$) (1974Iv01); 0.91 ps *4* from adopted B(E2)↑=0.0705 *29*. μ: from transient-fields in Coul. ex. (2001Ke02,2001Ke08). Other: +0.92 *26* (1978Ha13,1979BrZP) from Coul. ex. Q: from Coul. ex. (1971ChZT). 2021StZZ and 2016St14 list rounded value of 0.4 *2*. B(E2)↑: weighted average of 0.070 *10* from ($^{18}O,^{16}O\gamma$) (2020Ma37), 0.071 *3* from (e,e′); 0.0718 *29* (2014Al20), 0.065 *4* (1971ChZT), 0.087 *17* and 0.077 *15* (1960An07), 0.090 *18* (1959Al95) from Coul. ex. Others: 0.069 *5* from inelastic scattering (1996Ch03); see also (α,α') dataset for deformation parameter. β_2: from (pool p,p′). In (α,α') (1971Go36), negative sign is indicated from relative phase of $\sigma(\theta)$ for (α,α) and (α,α'). Others: 0.13 to 0.22 (see (π,π'), (p,p′); (d,d′); (^{3}He,^{3}He′); (α,α'); inelastic scattering).
2276.58 *3*	2+		A C FG I MNOP R UV XYZ	XREF: Others: AB E(level),Jπ: spin=2 from $\gamma\gamma(\theta)$ in $^{238}U(^{64}Ni,^{64}Ni'\gamma)$; parity from L(d,^{3}He)=L(t,α)=1 from 3/2−. Other: L(p,p′)=(0) proposed (1963Di11) for a weak group at 2275 and Jπ=0+ assumed by 1987Ba78 in the analysis of $\sigma(\theta)$ for a 2280 group in (α,α') suggest an additional (0+) level near 2275. B(E2)↑<0.0002 (e,e′) (1988Br10).
2477 *7*	6+		N P	XREF: N(?). E(level): from (p,p′). Other: 2490 from (d,d′). Jπ: L(d,d′)=6 from 0+.
2610.04 *9*	4+	1.73 ps *28*	C F I MNOP R UV XYZ	XREF: Others: AA, AB $T_{1/2}$: from DSA in Coul. Ex. (2001Ke08). Other: >0.31 ps from DSA in (n,n′γ) (1989Ko54). Jπ: 1264.3γ E2 to 2+; L(t,p)=L(e,e′)=L(p,p′)=4 from 0+. B(E4)↑=0.0018 *4* (e,e′) (1988Br10). β_4=0.09 (1969Be20), 0.07 (1974Ba74).
2867.40 *10*	0+	1.45 ps *10*	A C FG MNOP UV YZ	XREF: Others: AB Jπ: L(t,p)=0 from 0+; spin=0 from $\gamma\gamma(\theta)$ in $^{238}U(^{64}Ni,^{64}Ni'\gamma)$ Other: L(p,p′)=(2) from 0+ and L(d,^{3}He)=1+3 from 3/2− could indicate a separate level.

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Adopted Levels, Gammas (continued)

^{64}Ni Levels (continued)

E(level)[†]	J$^{\pi}$[‡]	T$_{1/2}$	XREF	Comments
				T$_{1/2}$: from B(E2) in Coulomb excitation (2020Ma37); also 1.4 ps *6* from RDDS in ^{62}Ni(^{18}O,^{16}Oγ) (2020Ma37). Value of 0.04 ps *2* from DSAM in (n,n′γ) (1989Ko54) seems discrepant.
2972.11 *6*	(1,2$^+$)	0.13 ps *+13−5*	A C FG I MN V Z	E(level): probable doublet in (t,p) and (p,p′). J$^{\pi}$: 2972.0γ to 0$^+$. *J*$^{\pi}$=(2$^+$) from L(t,p)=(2) for one member of the doublet. 2$^+$ proposed by 2020Ma37 in (^{18}O,^{16}Oγ) but no arguments given. T$_{1/2}$: from DSAM in (n,n′γ) (1989Ko54).
2982.94 *14*	(3$^+$)		F O Z	J$^{\pi}$: proposed by 2012Br15 based on $\gamma\gamma(\theta)$ in ^{238}U(^{64}Ni,^{64}Ni′γ).
3025.84 *4*	0$^+$	3.6 ps *12*	A C FG MNOP Z	XREF: Others: AB J$^{\pi}$: spin=0 from $\gamma\gamma(\theta)$ in ^{238}U(^{64}Ni,^{64}Ni′γ); 1680.1γ E2 to 2$^+$. T$_{1/2}$: from RDDS in ^{62}Ni(^{18}O,^{16}Oγ) (2020Ma37). Other: 4.1 ps *+5−4* from B(E2) in Coulomb excitation (2020Ma37) and adopted branching ratio of 1680γ.
3153.72 *4*	2$^+$		A c eFG R v	J$^{\pi}$: L(α,α')=2 from 0$^+$. Other: 1$^+$ reported by 2020Ma37 in ^{62}Ni(^{18}O,^{16}Oγ), but no arguments given.
3165.81 *15*	4$^+$	0.13 ps *+17−5*	c eF I MNOP v YZ	J$^{\pi}$: spin=4 from $\gamma\gamma(\theta)$ in ^{238}U(^{64}Ni,^{64}Ni′γ); parity from L(e,e′)=L(p,p′)=4 from 0$^+$. T$_{1/2}$: from DSAM in (n,n′γ) (1989Ko54). B(E4)↑=0.00058 *14* (e,e′) (1988Br10).
3275.99 *5*	2$^+$	0.24 ps *3*	A C FG I MNOP R V	J$^{\pi}$: L(t,p)=L(α,α')=2 from 0$^+$. T$_{1/2}$: from B(E2)↑=0.0025 *1* from (e,e′) (1988Br10) and adopted branching of 3275.9γ.
3395.89 *12*	4$^+$		C F I MNOP V YZ	J$^{\pi}$: spin=4 from $\gamma\gamma(\theta)$ in ^{238}U(^{64}Ni,^{64}Ni′γ); parity from L(t,α)=3 from 3/2$^-$.
3463.62 *5*	0$^{+\#}$		FG MN v Z	XREF: Others: AB J$^{\pi}$: spin=0 from $\gamma\gamma(\theta)$ in (n,γ) E=th (2020Ma37); 2117.86γ to 2$^+$; primary γ from 1$^-$ expected to be E1.
3482 *5*	(2$^+$,3,4$^+$)		MNO v	Additional information 2. J$^{\pi}$: probable 2136γ to 2$^+$ and 872γ to 4$^+$.
3559.90 *18*	3$^-$		C eF IJ MNOPQR v YZ	B(E3)↑=0.026 *5* (1988Br10,2002Ki06) β_3=0.203 *20* (1989Va02) XREF: R(3580). J$^{\pi}$: spin=3 from $\gamma\gamma(\theta)$ in ^{238}U(^{64}Ni,^{64}Ni′γ); L(t,p)=L(α,α')=L(p,p′)=L(e,e′)=3 from 0$^+$. B(E3)↑: from (e,e′), average (by 2002Ki06) of two values: 0.031 and 0.026 listed by 1988Br10 using two different models. Others: 0.022 or 0.024 ((α,α'), 1985Al24) and (π,π') (1993Pe09). β_3: from (pol p,p′). Others: 0.11-0.17 (see (p,p′); (d,d′); (^{3}He,^{3}He′); (α,α')).
3578.66 *5*	(1$^+$)		A e G	XREF: G(?). J$^{\pi}$: 3578.3γ to 0$^+$; 2012Pa39 in ^{64}Co β^- decay proposed (1$^+$) based on non-observation in (t,p) and 278.6γ most likely M1 from 3856 level with parity=(+).
3647.99 *7*	2$^+$		C FG MNOP V	J$^{\pi}$: spin=2 from $\gamma\gamma(\theta)$ in (n,γ) E=th (2020Ma37); L(t,α)=3 from 3/2$^-$.

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Adopted Levels, Gammas (continued)

^{64}Ni Levels (continued)

E(level)[†]	J$^{\pi}$[‡]	$T_{1/2}$	XREF	Comments
3748.99 *6*	2^+	>0.5 ps	c FG mnop uv	XREF: Others: AB J$^{\pi}$: spin=2 from $\gamma\gamma(\theta)$ in (n,γ) E=th (2020Ma37); 2403.25γ M1+E2 to 2^+. $T_{1/2}$: from line-shape analysis for 2403γ observed in ^{65}Cu(^{11}B,^{12}Cγ) (2020Ma37). See ^{62}Ni(^{18}O,^{16}Oγ) dataset.
3749.29 *17*	$4^{(-)}$		c mnop R uv YZ	J$^{\pi}$: spin=4 from $\gamma\gamma(\theta)$ in ^{238}U(^{64}Ni,^{64}Ni$'\gamma$); 189γ to 3^- and 99.9γ from 5^- are most likely M1. But L(α,α')=(4) for a group at 3745 suggests (4^+).
3798.7	2^+		c FG MNO uv	Additional information 3. E(level): from (^{18}O,^{16}Oγ) (2020Ma37). Other: 3797 *5* from (p,p$'$). J$^{\pi}$: probable 2451γ to 2^+; 2020Ma37 in (n,γ) E=th state that $J^{\pi}=2^+$ is firmly established, but no further details are given.
3808 *7*			c e MN uv	E(level): from (p,p$'$).
3849.13 *17*	5^-		c eF I MnOP R V YZ	XREF: Others: AA J$^{\pi}$: L(e,e$'$)=L(α,α')=5 from 0^+ and L(t,α)=4 from $3/2^-$. Possible dominant configuration=$\nu g_{9/2}\nu p_{1/2}$ (1994Pa20). B(E5)↑=0.00055 *3* (e,e$'$) (1988Br10).
3856.59 *22*	0^+		A c eFG n	J$^{\pi}$: 2020Ma37 in (n,γ) E=th note that 0^+ is established based on a 702γ-3154γ correlation cascade from a (n,γ) E=th experiment at ILL, which has not been published.
3963 *7*	(0^+ to 4^+)		C NOP	Additional information 4. E(level): weighted average of 3958 *10* from (t,p) and 3965 *7* from (p,p$'$). J$^{\pi}$: probable 2671γ to 2^+.
4076 *3*	4^+		cDe I Mn p r V	E(level): from (e,e$'$). L(α,α')=(4,5) suggests a doublet with $J^{\pi}=4^+$ and 5^-. J$^{\pi}$: L(e,e$'$)=4 from 0^+ and L(t,α)=3 from $3/2^-$. B(E4)↑=0.00030 *7* (e,e$'$) (1988Br10).
4085.07 *19*	$5^{(-)}$		c eF nOp r YZ	J$^{\pi}$: spin=5 from $\gamma\gamma(\theta)$ in ^{238}U(^{64}Ni,^{64}Ni$'\gamma$); 236.2γ to 5^- is most likely M1; L(α,α')=(4,5) suggests a doublet with $J^{\pi}=4^+$ and 5^-.
4137 *7*			e N	E(level): from (p,p$'$).
4172.53 *19*	$6^{(-)}$		n YZ	J$^{\pi}$: spin=6 from $\gamma\gamma(\theta)$ in ^{238}U(^{64}Ni,^{64}Ni$'\gamma$); 323.4γ to 5^- and 359.4γ from 7^- are most likely M1. Possible configuration=$\nu g_{9/2}\nu p_{3/2}+\nu g_{9/2}\nu f^{-1}_{5/2}$ (1994Pa20).
4174 *7*	(1,2)		nO	Additional information 5. J$^{\pi}$: probable 4174γ to 0^+.
4216 *3*	4^+		C I NO V	XREF: C(4211)N(4210)V(4211). Additional information 6. E(level): weighted average of 4218 *3* from (e,e$'$), 4210 *7* from (p,p$'$), 4211 *10* from (t,p) and 4211 *11* from (t,α). J$^{\pi}$: L(e,e$'$)=4 and L(t,α)=3 from $3/2^-$, but L(t,p)=(0) is in disagreement. B(E4)↑=0.0011 *3* (e,e$'$) (1988Br10).
4244 *7*			C N u	E(level): weighted average of 4239 *10* from (t,p) and 4247 *7* from (p,p$'$).
4268.22 *5*	0^+[#]		A C FG NO u	J$^{\pi}$: 688.0γ to (1^+), 1114.6γ to 2^+; probable allowed β^- feeding from 1^+ parent.
4285 *7*			N u	E(level): from (p,p$'$). J$^{\pi}$: L(d,^{3}He)=3 from $3/2^-$ for a group at 4290 *50*.

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Adopted Levels, Gammas (continued)

^{64}Ni Levels (continued)

E(level)[†]	Jπ[‡]	$T_{1/2}$	XREF	Comments
4346 *6*			C I NO v	Additional information 7. E(level): weighted average 4344 *10* from (t,p), 4347 *6* from (e,e′), and 4346 *7* from (p,p′). Jπ: L(t,α)=3 from 3/2⁻ gives $J^{\pi}=(1 \text{ to } 5)^+$ for a group at 4358 *11*.
4369 *7*			c N v	E(level): from (p,p′).
4397 *7*			NO	Additional information 8. E(level): from (p,p′).
4417.6 *3*	(0^+ to 4^+)		N Z	Jπ: 2141γ to 2^+.
4453 *7*			NO	Additional information 9. E(level): from (p,p′).
4477.1 *4*	(6^+)		N Z	Jπ: proposed by 2012Br15 in ^{238}U(^{64}Ni,^{64}Ni′γ).
4493 *6*	2^+		C I N	E(level): from (e,e′). Others: 4491 *10* from (t,p) and 4494 *7* from (p,p′). Jπ: L(e,e′)=2 from 0^+. B(E2)↑=0.0014 *2* from (e,e′) (1988Br10).
4521 *7*			C NO	XREF: O(4510). E(level): weighted average of 4524 *10* from (t,p) and 4520 *7* from (p,p′).
4531.91 *22*	7^-		DE YZ	XREF: D(4600)E(4520). Jπ: spin=7 from γγ(θ) in ^{238}U(^{64}Ni,^{64}Ni′γ); L(α,^{2}He)=7 from 0^+. Possible configuration=$\nu g_{9/2}\nu p_{3/2}+\nu g_{9/2}\nu,f^{-1}_{5/2}$ (1994Pa20). 1990Fi07 suggest configuration=$\nu f_{5/2}\nu g_{9/2}$.
4556.4 *4*	(0^+,1^+,2^+)		A C N v	XREF: N(4548). Jπ: probable allowed β⁻ feeding from 1^+ parent.
4573.16 *5*	2^+		G I NO v	Jπ: L(e,e′)=2 from 0^+; 4572.9γ to 0^+, probable 1963γ to 4^+. B(E2)↑=0.0013 *2* in (e,e′) (1988Br10).
4584 *7*			N R	E(level): from (p,p′).
4615.57 *7*	(1,2)		c G N	XREF: c(4620). Jπ: 4615.3γ to 0^+.
4640.66 *6*	2^+	25.9 fs *+7−5*	c G I NO V	XREF: c(4620)N(4632). E(level): possible doublet in (p,p′). Jπ: L(e,e′)=2 from 0^+ and L(t,α)=3 from $3/2^-$. $T_{1/2}$: from B(E2)↑=0.0030 *5* in (e,e′) (1988Br10) and adopted branching of 4640.3γ.
4670 *7*			N	
4692 *7*			C N	E(level): from (p,p′). Other: 4692 *10* from (t,p).
4704.12 *6*	$0^{+\#}$		FG	Jπ: 3358.2γ to 2^+ and primary γ from 1^-.
4711.99 *23*	(6^-)		Z	Jπ: proposed in ^{238}U(^{64}Ni,^{64}Ni′γ) based on 6262.8γ to 5^-.
4719 *3*	4^+		c I NO	XREF: c(4732)O(4730). Additional information 10. E(level): weighted average of 4719 *3* from (e,e′), and 4720 *7* from (p,p′). Probable doublet in (p,p′γ). Jπ: L(e,e′)=4 from 0^+. B(E4)↑=0.00040 *10* (e,e′) (1988Br10).
4741 *7*			c N	XREF: c(4732). E(level): from (p,p′).
4759 *6*	(1,2)		C I NO V	Additional information 11. E(level): weighted average of 4750 *10* from (t,p), 4760 *6* from (e,e′), 4762 *7* from (p,p′) and 4762

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Adopted Levels, Gammas (continued)

^{64}Ni Levels (continued)

E(level)†	Jπ‡	XREF	Comments
			11 from (t,α).
			Jπ: probable 4759γ to 0+.
4800 *7*	(1+ to 5+)	N V	E(level): weighted average of 4796 *7* from (p,p′) and 4811 *11* from (t,α).
			Jπ: L(t,α)=3 from 3/2−.
4868.54 *6*	(1,2)	G	Jπ: 4868.3γ to 0+.
4889 *6*	2+	C I N V	E(level): weighted average of 4886 *10* from (t,p), 4887 *6* from (e,e′), 4894 *7* from (p,p′), and 4888 *11* from (t,α).
			Jπ: L(t,p)=2 from 0+ and L(t,α)=1 from 3/2−.
4928 *7*		NO	Additional information 12.
			E(level): from (p,p′).
4962.2 *6*	(6−,7−,8−)	Y	Jπ: 430.3γ to 7− most likely M1.
4963 *7*	(0+ to 4+)	C NO u	XREF: O(4970)u(5000).
			Additional information 13.
			E(level): weighted average of 4958 *10* from (t,p) and 4966 *7* from (p,p′).
			Jπ: probable 3617γ to 2+.
4991 *6*	2+	C I NO uv	XREF: O(5000)u(5000)v(5011).
			Additional information 14.
			E(level): weighted average of 4993 *6* from (e,e′), 4985 *10* from (t,p), and 4991 *7* from (p,p′). Others: 5000 *50* from (d,^{3}He) probably a multiplet; 5011 *11* from (t,α) probably a doublet.
			Jπ: L(e,e′)=2 from 0+. See also comment for 5009 level.
			B(E2)↑=0.0030 *2* from (e,e′) (1988Br10).
5009 *10*		N uv	XREF: u(5000)v(5011).
			E(level): from (p,p′).
			Jπ: L(t,α)=3 from 3/2− from a probable doublet at 5011 *11* and L(d,^{3}He)=3 from 3/2− for a probable multiplet at 5000 *50*.
5027 *10*		c N uv	E(level): weighted average of 5026 *10* from (t,p) and 5028 *10* from (p,p′).
			Jπ: see comment for 5009 level.
5065 *10*		N	
5093 *3*	4+	C I NO V	Additional information 15.
			E(level): weighted average of 5085 *10* from (t,p), 5095 *3* from (e,e′), 5087 *10* from (p,p′) and 5090 *11* from (t,α).
			Jπ: L(e,e′)=4 from 0+ and L(t,α)=3 from 3/2−.
			B(E4)↑=0.0013 *3* from (e,e′) (1988Br10).
5107 *10*		N	
5123 *10*		N	
5155.56 *7*	(0+,1,2,3−)	C G No	XREF: C(5146)o(5160).
			Jπ: 3809.6γ to 2+ and primary γ from 1−.
5169 *10*		C No	XREF: C(5164)o(5160).
			E(level): weighted average of 5164 *10* from (t,p) and 5174 *10* from (p,p′).
5188 *10*		N	
5215 *3*	4+	C E I NO V	XREF: E(5200).
			Additional information 16.
			E(level): weighted average of 5209 *10* from (t,p), 5216 *3* from (e,e′), 5217 *10* from (p,p′) and 5210 *11* from (t,α). Other: 5200 *50* from (^{12}C,^{10}C).
			Jπ: L(e,e′)=4 from 0+ and L(t,α)=3 from 3/2−.
			B(E4)↑=0.00053 *14* from (e,e′) (1988Br10).
5229 *10*		N	
5264 *10*		c N v	XREF: c(5273)v(5278).
			E(level): from (p,p′).
5285 *10*	(2+,3,4+)	c NO v	XREF: c(5273)v(5278).

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Adopted Levels, Gammas (continued)

^{64}Ni Levels (continued)

E(level)†	Jπ‡	XREF	Comments
			Additional information 17.
			E(level): from (p,p′).
			Jπ: probable 2675γ to 4+ and 3939γ to 2+.
5332 *10*		N	
5355 *10*		C N	E(level): weighted average of 5358 *10* from (t,p) and 5351 *10* from (p,p′).
5369 *3*	3−	I N R v	XREF: v(5378).
			E(level): from (e,e′). Others: 5370 *10* from (p,p′), 5378 *11* from (t,α).
			Jπ: L(e,e′)=3 from 0+ and L(t,α)=2 from 3/2−. But the 5378 group in (t,α) may correspond to 5369 and/or 5386.
			B(E3)↑=0.0020 *4* from (e,e′) (1988Br10).
5383 *7*	(0+ to 4+)	NO v	XREF: v(5378).
			Additional information 18.
			E(level): from (p,p′).
			Jπ: probable 3106γ and 4037γ to 2+.
5408 *6*	2+	c I n	E(level): from (e,e′).
			Jπ: L(e,e′)=2 from 0+.
			B(E2)↑=0.0036 *5* from (e,e′) (1988Br10).
5418.21 *7*	(1)−	c G n V	Jπ: L(t,α)=2 from 3/2− and 5417.9γ to 0+.
5439 *10*	(5−)	DE N	E(level): weighted average of 5430 *50* from (α,^{2}He), 5410 *50* from (^{12}C,^{10}C), and 5441 *10* from (p,p′).
			Jπ: L(α,^{2}He)=5 from 0+; possible configuration=$\nu f_{5/2}\otimes\nu d_{5/2}$ (1990Fi07).
5484 *3*	(3−)	I NO UV	Additional information 19.
			E(level): from (e,e′). Other: 5480 *10* from (p,p′), 5481 *11* from (t,α), 5500 *100* from (d,^{3}He).
			Jπ: L(e,e′)=(3) from 0+, but L(t,α)=1 from 3/2− gives (0 to 3)+.
			B(E3)↑=0.00067 *13* from (e,e′) (1988Br10).
5507 *10*		N	
5536 *10*		C NO	XREF: O(5550).
			E(level): weighted average of 5535 *10* from (t,p) and 5537 *10* from (p,p′).
5567 *11*		V	
5614 *10*	(2+)	C	Jπ: L(t,p)=(2) from 0+.
5663 *10*	(1+ to 5+)	C V	E(level): weighted average of 5660 *10* from (t,p) and 5667 *11* from (t,α).
			Jπ: L(t,α)=3 from 3/2−.
5734 *3*	4+	I	Jπ: L(e,e′)=4 from 0+.
			B(E4)↑=0.0022 *5* from (e,e′) (1988Br10).
5735.8 *3*	(7−)	Z	Jπ: proposed in ^{238}U(^{64}Ni,^{64}Ni′γ).
5759 *11*	0− to 4−	V	Jπ: L(t,α)=2 from 3/2−.
5768.75 *8*	0+#	FG NO	Jπ: 3492.3γ to 2+ and primary γ from 1−.
5812.0 *3*	8+	DE YZ	Jπ: spin=8 from γγ(θ) in ^{238}U(^{64}Ni,^{64}Ni′γ); L(α,^{2}He)=8,(6) from 0+.
			Possible configuration=$\nu g^2_{9/2}$ (1990Fi07,1994Pa20).
5817 *6*	3−	I	Jπ: L(e,e′)=3 from 0+.
			B(E3)↑=0.00073 *14* from (e,e′) (1988Br10).
5843 *11*		V	
5870		NO	E(level): from (p,p′) and (p,p′γ).
5902 *11*	(1−,2−)	NO V	XREF: N(5910)O(5910).
			E(level): from (t,α).
			Jπ: L(t,α)=0 from 3/2−.
5976 *11*	(1+ to 5+)	V	Jπ: L(t,α)=3 from 3/2−.
6018 *3*	3−	I	Jπ: L(e,e′)=3 from 0+.
			B(E3)↑=0.00118 *23* from (e,e′) (1988Br10).

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Adopted Levels, Gammas (continued)

^{64}Ni Levels (continued)

E(level)†	Jπ‡	XREF	Comments
6040 *50*	(6+)	DE	E(level): weighted average of 6030 *50* from (α,^{2}He) and 6050 *50* from (^{12}C,^{10}C). Jπ: L(α,^{2}He)=6,(8) from 0+. Possible configuration=$\nu g_{9/2}\nu d_{5/2}$ (1990Fi07).
6060 *11*	1−,2−	NO UV	E(level): from (t,α). Other: 6.05E3 *10* from (d,^{3}He). Jπ: L(t,α)=L(d,^{3}He)=0 from 3/2−.
6116 *3*	3−	I V	E(level): from (e,e′). Other: 6121 *11* from (t,α). Jπ: L(e,e′)=3 from 0+. B(E3)↑=0.00118 *23* from (e,e′) (1988Br10).
6182 *11*		V	
6188.7 *4*	9(−)	Z	Jπ: spin=9 from γγ(θ) in ^{238}U(^{64}Ni,^{64}Ni′γ); 1656.8γ to 7−.
6220 *11*		V	
6444 *11*	(1,2)+	O V	Additional information 20. E(level): from (t,α). Jπ: L(t,α)=3 from 3/2−; probable 6444γ to 0+.
6512 *11*	1−,2−	V	Jπ: L(t,α)=0 from 3/2−.
6622 *11*		V	
6656 *11*		uV	E(level): from (t,α). Jπ: L(d,^{3}He)=0 from 3/2− for a doublet at 6700 *100*.
6687 *11*	1−,2−	uV	E(level): from (t,α). Jπ: L(t,α)=0 from 3/2−.
6754 *11*		NO V	E(level): from (t,α).
6796.0 *5*	(10+)	Z	Jπ: proposed in ^{238}U(^{64}Ni,^{64}Ni′γ); 984.0γ to 8+.
6822 *11*		V	
6838 *11*		V	
6861 *11*		V	
7020 *10*	(1,2)	O	Additional information 21. Jπ: probable 7020γ to 0+.
7130		NO	
7220 *10*	(1,2)	O	Additional information 22. Jπ: probable 7220γ to 0+.
7.30×10^{3} *10*	0−,1−,2−,3−,4−	U	Jπ: L(d,^{3}He)=2 from 3/2−.
7730 *10*	(1,2)	O	Additional information 23. Jπ: probable 7330γ to 0+.
7.95×10^{3} *10*	0−,1−,2−,3−,4−	U	Jπ: L(d,^{3}He)=2 from 3/2−.
8240 *10*	(1,2)	O	Additional information 24. Jπ: probable 8240γ to 0+.
9657.86 *20*		H	
9658.05 *20*	0−,1−	H	Jπ: s-wave resonance (2018MuZY).
9658.81 *20*	0−,1−	H	Jπ: s-wave resonance (2018MuZY).
9664.17 *20*		H	
9665.97 *20*		H	
9666.31 *20*		H	
9666.36 *20*		H	
9666.48 *20*		H	
9667.09 *20*		H	
9669.36 *20*		H	
9670.03 *20*		H	
9671.23 *20*		H	
9671.33 *21*		H	
9673.41 *20*		H	
9674.33 *20*		H	
9675.02 *21*		H	
9676.72 *20*		H	
9676.83 *21*		H	

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Adopted Levels, Gammas (continued)

^{64}Ni Levels (continued)

E(level)†	$T_{1/2}$	XREF	Comments
9680.24 *22*		H	
9686.86 *22*		H	
9689.29 *20*		H	
9711.36 *20*		H	
13.2×10^3 *3*	4.8 MeV *3*	I	E(level),$T_{1/2}$: energy and width for a giant quadrupole resonance (1974Gu16).
15.4×10^3 *2*	4.2 MeV *2*	T	E(level),$T_{1/2}$: energy and width for a giant quadrupole resonance (1990Ga07).
15.60×10^3 *30*	5.64 MeV *40*	R	E(level),$T_{1/2}$: energy and width for a giant quadrupole resonance (1992Yo01).
16.4×10^3 *10*	6.8 MeV *1*	J	E(level),$T_{1/2}$: energy and width for a giant quadrupole resonance (1989Oa01).

† From a least-squares fit to γ-ray energies with uncertainties for levels connected with those γ transitions and from reaction data for others, unless otherwise noted. Above ≈4 MeV, due to high level density and limited resolution the correspondence of levels from different reactions is somewhat ambiguous.

‡ Above 3.5 MeV, due to high level density L-transfer values available from only one reaction such as (t,α) or (d,^{3}He) are considered tentative for J^π assignments.

From 2020Ma37 in (n,γ) E=th. The authors state that the decay pattern is only consistent with 0^+ based on an unpublished (n,γ) E=th experiment at ILL and that $\gamma\gamma(\theta)$ of a cascade toward 1346 level also yields firm 0^+ assignment.

Adopted Levels, Gammas (continued)

γ(^{64}Ni)

E_i(level)	J_i^π	E_γ[†]	I_γ[†]	E_f	J_f^π	Mult.	δ	α[&]	Comments
1345.777	2^+	1345.83 *3*	100	0.0	0^+	E2		1.63×10^{-4}	B(E2)(W.u.)=7.76 *26* E_γ: weighted average of 1345.8 *1* from ^{64}Co β^- decay (0.30 s), 1345.77 *6* from ^{64}Cu ε decay (12.700 h), 1345.84 *3* from (n,γ) E=th, 1346.0 *1* from ^{208}Pb(^{64}Ni,^{64}Ni′γ), and 1345.8 *1* from ^{238}U(^{64}Ni,^{64}Ni′γ). Other: 1345.1 *2* from (^{70}Zn,Xγ). Mult.: from ΔJ=2, Q from γγ(θ) data in (^{64}Ni,^{64}Ni′γ), and RUL.
2276.58	2^+	930.81[‡] *3*	100.0 *22*	1345.777	2^+	(M1+E2)	+0.75 *20*		E_γ: others: 930.8 *1* from ^{64}Co β^- decay (0.30 s), 930.8 *1* from ^{208}Pb(^{64}Ni,^{64}Ni′γ), and 930.8 *1* from ^{238}U(^{64}Ni,^{64}Ni′γ). I_γ: from ^{64}Co β^- decay (0.30 s). Other: 100.0 *23* from ^{238}U(^{64}Ni,^{64}Ni′γ). Mult.,δ: D+Q and δ from γ(θ) in (n,n′γ); (M1+E2) from level scheme. Other: δ(Q/D)≈−0.9 from γγ(θ) in ^{238}U(^{64}Ni,^{64}Ni′γ).
		2276.6 *1*	0.84 *23*	0.0	0^+				E_γ: from ^{64}Co β^- decay (0.30 s). Other: 2277 *2* from ^{238}U(^{64}Ni,^{64}Ni′γ). I_γ: from ^{238}U(^{64}Ni,^{64}Ni′γ). Other: <2.46 from ^{64}Co β^- decay.
2610.04	4^+	1264.3 *1*	100	1345.777	2^+	E2		1.62×10^{-4}	B(E2)(W.u.)=6.7 *+13−9* E_γ: from (^{64}Ni,^{64}Ni′γ). Other: 1264.0 *2* from (^{70}Zn,Xγ). Mult.: ΔJ=2, Q from γ(θ) in (n,n′γ); and RUL.
2867.40	0^+	1521.6[‡] *1*	100	1345.777	2^+	E2		1.91×10^{-4}	B(E2)(W.u.)=3.15 *+23−21* E_γ: others: 1521.6 *1* from ^{64}Co β^- decay (0.30 s), 1521.5 *4* from ^{208}Pb(^{64}Ni,^{64}Ni′γ) and 1521.5 *2* from ^{238}U(^{64}Ni,^{64}Ni′γ). Mult.: Q from γγ(θ) in ^{238}U(^{64}Ni,^{64}Ni′γ); M2 ruled out by RUL.
2972.11	$(1,2^+)$	695.6 *3*	80 *30*	2276.58	2^+				E_γ: weighted average of 695.7 *3* from ^{64}Co β^- decay (0.30 s) and 695.5 *3* from ^{238}U(^{64}Ni,^{64}Ni′γ). I_γ: from ^{64}Co β^- decay (0.30 s). Other: 80 *40* from ^{238}U(^{64}Ni,^{64}Ni′γ).
		1626.30[‡] *7*	100[‡] *20*	1345.777	2^+				E_γ: others: 1626.3 *1* from ^{64}Co β^- decay (0.30 s) and 1626.4 *4* from ^{238}U(^{64}Ni,^{64}Ni′γ). I_γ: others: 100 *40* from ^{64}Co β^- decay (0.30 s) and 100 *60* from ^{238}U(^{64}Ni,^{64}Ni′γ).
		2972.03 *6*	69 *8*	0.0	0^+				E_γ: weighted average of 2972.0 *1* from ^{64}Co β^- decay (0.30 s) and 2972.04 *6* from (n,γ) E=th. Other: 2973 *1* from ^{238}U(^{64}Ni,^{64}Ni′γ).

$^{64}_{28}Ni_{36}$-10

Adopted Levels, Gammas (continued)

γ(^{64}Ni) (continued)

E_i(level)	J_i^π	E_γ[†]	I_γ[†]	E_f	J_f^π	Mult.	α[&]	Comments
								E_γ: weighted average of 2972.0 *1* from ^{64}Co β^- decay (0.30 s) and 2972.04 *6* from (n,γ) E=th. Other: 2973 *1* from ^{238}U(^{64}Ni,^{64}Ni′γ).
								I_γ: weighted average of 60 *20* from ^{64}Co β^- decay (0.30 s), 70 *8* from (n,γ) E=th, and 80 *40* from ^{238}U(^{64}Ni,^{64}Ni′γ).
2982.94	(3$^+$)	706.5 *2*	100 *12*	2276.58	2$^+$			
		1637.0 *3*	64 *12*	1345.777	2$^+$			
3025.84	0$^+$	749.23[‡] *4*	3.6[‡] *2*	2276.58	2$^+$	[E2]	5.05×10^{-4}	B(E2)(W.u.)=1.5 *+8−4*
								I_γ: from Iγ(749γ)/Iγ(1680γ)=3.6 *2*/100 in (n,γ) E=th (2020Ma37).
		1680.07[‡] *4*	100[‡]	1345.777	2$^+$	E2	2.41×10^{-4}	B(E2)(W.u.)=0.75 *+37−19*
								E_γ: others: 1680.1 *1* from ^{64}Co β^- decay and 1680.1 *2* from ^{238}U(^{64}Ni,^{64}Ni′γ).
								Mult.: Q from γγ(θ) in ^{238}U(^{64}Ni,^{64}Ni′γ); M2 ruled out by RUL.
3153.72	2$^+$	877.16 *5*	62 *9*	2276.58	2$^+$			E_γ: weighted average of 877.2 *1* from ^{64}Co β^- decay (0.30 s) and 877.15 *5* from (n,γ) E=th.
								I_γ: weighted average of 58 *9* from ^{64}Co β^- decay (0.30 s) and 73 *15* from (n,γ) E=th.
		1807.98 *5*	73 *12*	1345.777	2$^+$			E_γ: weighted average of 1808.0 *1* from ^{64}Co β^- decay (0.30 s) and 1807.97 *5* from (n,γ) E=th.
								I_γ: from ^{64}Co β^- decay (0.30 s). Other: 75 *16* from (n,γ) E=th.
		3153.69 *7*	100 *5*	0.0	0$^+$			E_γ: weighted average of 3153.7 *1* from ^{64}Co β^- decay (0.30 s) and 3153.68 *7* from (n,γ) E=th.
								I_γ: from (n,γ) E=th. Other: 100 *18* from ^{64}Co β^- decay (0.30 s).
3165.81	4$^+$	1820.0 *2*	100	1345.777	2$^+$	E2	2.94×10^{-4}	B(E2)(W.u.)=14 *+9−7*
								E_γ: weighted average of 1820.4 *5* from ^{208}Pb(^{64}Ni,^{64}Ni′γ) and 1819.9 *2* from ^{238}U(^{64}Ni,^{64}Ni′γ).
								Mult.: Q from γγ(θ) in ^{238}U(^{64}Ni,^{64}Ni′γ); M2 ruled out by RUL.
3275.99	2$^+$	1930.2 *1*	26 *8*	1345.777	2$^+$	(M1+E2)[@]		B(M1)(W.u.)=0.0026 *8*; B(E2)(W.u.)=1.19 *34*
								E_γ: from ^{64}Co β^- decay (0.30 s).
								I_γ: weighted average of 14 *9* from ^{64}Co β^- decay (0.30 s) and 32 *6* from (n,γ) E=th.
								B(M1)(W.u.) for pure M1; B(E2)(W.u.) for pure E2.
		3275.90[‡] *6*	100[‡] *5*	0.0	0$^+$	[E2]		B(E2)(W.u.)=0.33 *+5−4*
								E_γ: other: 3275.9 *1* from ^{64}Co β^- decay.
								I_γ: other: 100 *23* from ^{64}Co β^- decay.
3395.89	4$^+$	230.0 *3*	6.7 *30*	3165.81	4$^+$			
		413.0 *3*	7.4 *19*	2982.94	(3$^+$)			
		785.9 *2*	68 *11*	2610.04	4$^+$			E_γ: other: 785.7 *5* from ^{208}Pb(^{64}Ni,^{64}Ni′γ).
								I_γ: weighted average of 81 *13* from ^{208}Pb(^{64}Ni,^{64}Ni′γ) and 59 *11* from ^{238}U(^{64}Ni,^{64}Ni′γ).

$^{64}_{28}Ni_{36}$-11

Adopted Levels, Gammas (continued)

γ(^{64}Ni) (continued)

E_i(level)	J_i^π	E_γ[†]	I_γ[†]	E_f	J_f^π	Mult.	δ	α[&]	Comments
3395.89	4$^+$	2049.9 *2*	100 *15*	1345.777	2$^+$	(E2)			E_γ: from ^{238}U(^{64}Ni,^{64}Ni′γ). Other: 2049.8 *4* from ^{208}Pb(^{64}Ni,^{64}Ni′γ). I_γ: other: 100 *25* from ^{208}Pb(^{64}Ni,^{64}Ni′γ); Iγ(2050γ)/Iγ(786γ)=40/60 in (p,p′γ) is discrepant. Mult.: Q from γγ(θ) in ^{238}U(^{64}Ni,^{64}Ni′γ); E2 from level scheme.
3463.62	0$^+$	310[‡]	4.6[‡]	3153.72	2$^+$				
		492[‡]	1.0[‡]	2972.11	(1,2$^+$)				
		1187.01 *5*	100 *20*	2276.58	2$^+$				E_γ: weighted average of 1187.02 *3* from (n,γ) E=th and 1186.5 *3* from ^{238}U(^{64}Ni,^{64}Ni′γ). I_γ: from (n,γ) E=th.
		2117.86[‡] *7*	19.6[‡] *20*	1345.777	2$^+$	(E2)			Mult.: Q from γγ(θ) in (n,γ) E=th; E2 from level scheme.
3482	(2$^+$,3,4$^+$)	872[#]		2610.04	4$^+$				
		2136[#]		1345.777	2$^+$				
3559.90	3$^-$	1283.4 *3*	28 *6*	2276.58	2$^+$				E_γ: weighted average of 1284.0 *6* from ^{208}Pb(^{64}Ni,^{64}Ni′γ) and 1283.3 *3* from ^{238}U(^{64}Ni,^{64}Ni′γ). I_γ: from ^{238}U(^{64}Ni,^{64}Ni′γ). Other: 27 *9* from ^{208}Pb(^{64}Ni,^{64}Ni′γ).
		2213.8 *3*	100 *13*	1345.777	2$^+$	(E1)		8.10×10^{-4}	E_γ: weighted average of 2214.4 *5* from ^{208}Pb(^{64}Ni,^{64}Ni′γ) and 2213.7 *2* from ^{238}U(^{64}Ni,^{64}Ni′γ). I_γ: from ^{238}U(^{64}Ni,^{64}Ni′γ). Other: 100 *27* from ^{208}Pb(^{64}Ni,^{64}Ni′γ). Mult.: D from γγ(θ) in ^{238}U(^{64}Ni,^{64}Ni′γ); E1 from level scheme.
		3560[#]		0.0	0$^+$	[E3]			
3578.66	(1$^+$)	2232.89[‡] *6*	100[‡] *10*	1345.777	2$^+$				E_γ,I_γ: other: 2232.9 *1* with Iγ=100 *72* from ^{64}Co β^- decay.
		3578.3 *1*	30.5 *15*	0.0	0$^+$				E_γ: weighted average of 3578.3 *1* from ^{64}Co β^- decay and 3578.32 *8* from (n,γ) E=th. I_γ: from (n,γ) E=th. Other: <43 from ^{64}Co β^- decay.
3647.99	2$^+$	2302.30[‡] *17*	100[‡] *10*	1345.777	2$^+$	(M1+E2)[@]			
		3647.86[‡] *7*	53.8[‡] *28*	0.0	0$^+$				
3748.99	2$^+$	1473	20	2276.58	2$^+$				E_γ,I_γ: from (^{18}O,^{16}Oγ) (2020Ma37).
		2403.25[‡] *7*	100[‡] *9*	1345.777	2$^+$	E2+M1	+1.23 *10*		B(M1)(W.u.)<9.9×10^{-4}; B(E2)(W.u.)<0.42

$^{64}_{28}Ni_{36}$-12

Adopted Levels, Gammas (continued)

γ(^{64}Ni) (continued)

E_i(level)	J_i^π	E_γ[†]	I_γ[†]	E_f	J_f^π	Mult.	δ	α[&]	Comments
									E_γ: other: 2400 from (p,p′γ). Mult.,δ: D+Q and δ from γγ(θ) in (n,γ) E=th (2020Ma37); E1+M2 disfavored by the large δ and RUL.
3748.99	2$^+$	3748.77[‡] *8*	29.6[‡] *15*	0.0	0$^+$				
3749.29	4$^{(-)}$	189.2 *3*	100 *9*	3559.90	3$^-$	(M1)		0.00889	E_γ: weighted average of 189.0 *4* from ^{208}Pb(^{64}Ni,^{64}Ni′γ) and 189.3 *3* from ^{238}U(^{64}Ni,^{64}Ni′γ). I_γ: from ^{238}U(^{64}Ni,^{64}Ni′γ). Other: 100 *17* from ^{208}Pb(^{64}Ni,^{64}Ni′γ). Mult.: D from γγ(θ) in ^{238}U(^{64}Ni,^{64}Ni′γ); M1 is most likely.
		583.4 *3*	35 *6*	3165.81	4$^+$	(E1)		3.34×10^{-4}	E_γ: other: 583.4 *6* from ^{208}Pb(^{64}Ni,^{64}Ni′γ). I_γ: weighted average of 33 *8* from ^{208}Pb(^{64}Ni,^{64}Ni′γ) and 36 *6* from ^{238}U(^{64}Ni,^{64}Ni′γ). Mult.: D from γγ(θ) in ^{238}U(^{64}Ni,^{64}Ni′γ); E1 from level scheme.
		766.6 *4*	7.6 *15*	2982.94	(3$^+$)				
		1139.4 *3*	18 *6*	2610.04	4$^+$				E_γ: other: 1130 from (p,p′γ).
3798.7	2$^+$	2453		1345.777	2$^+$	(M1+E2)[@]			E_γ: from level-energy difference.
3849.13	5$^-$	99.9 *3*	4.5 *13*	3749.29	4$^{(-)}$	[M1]		0.0469 *8*	E_γ: weighted average of 99.6 *6* from ^{208}Pb(^{64}Ni,^{64}Ni′γ) and 100.0 *3* from ^{238}U(^{64}Ni,^{64}Ni′γ). I_γ: weighted average of 4.2 *14* from ^{208}Pb(^{64}Ni,^{64}Ni′γ) and 4.8 *13* from ^{238}U(^{64}Ni,^{64}Ni′γ).
		289 *1*	0.52 *31*	3559.90	3$^-$	[E2]		0.0106 *2*	
		453.2 *3*	8.6 *25*	3395.89	4$^+$	(E1)		6.25×10^{-4}	E_γ: weighted average of 452.9 *6* from ^{208}Pb(^{64}Ni,^{64}Ni′γ) and 453.3 *3* from ^{238}U(^{64}Ni,^{64}Ni′γ). I_γ: unweighted average of 11.1 *14* from ^{208}Pb(^{64}Ni,^{64}Ni′γ) and 6.1 *13* from ^{238}U(^{64}Ni,^{64}Ni′γ). Mult.: D from γγ(θ) in ^{238}U(^{64}Ni,^{64}Ni′γ); E1 from level scheme.
		683.6 *4*	0.9 *4*	3165.81	4$^+$				
		1239.3 *3*	100.0 *9*	2610.04	4$^+$	(E1)		1.47×10^{-4}	E_γ: unweighted average of 1239.0 *3* from ^{208}Pb(^{64}Ni,^{64}Ni′γ), 1239.0 *1* from ^{238}U(^{64}Ni,^{64}Ni′γ), and 1239.9 *3* from (^{70}Zn,Xγ). I_γ: other: 100 *10* from ^{208}Pb(^{64}Ni,^{64}Ni′γ). Mult.: D from γγ(θ) in ^{238}U(^{64}Ni,^{64}Ni′γ); E1 from level scheme.
		2503[#a]		1345.777	2$^+$	[E3]			
3856.59	0$^+$	278.6 *3*	10 *5*	3578.66	(1$^+$)				E_γ,I_γ: from ^{64}Co β^- decay.
		702.2 *3*	100 *5*	3153.72	2$^+$				E_γ,I_γ: from ^{64}Co β^- decay.

$^{64}_{28}Ni_{36}$-13

Adopted Levels, Gammas (continued)

γ(^{64}Ni) (continued)

E_i(level)	J_i^π	E_γ[†]	I_γ[†]	E_f	J_f^π	Mult.	α[&]	Comments
3963	(0$^+$ to 4$^+$)	2617[#]		1345.777	2$^+$			
4085.07	5$^{(-)}$	236.2 *3*	39 *14*	3849.13	5$^-$			E_γ: weighted average of 236.5 *5* from ^{208}Pb(^{64}Ni,^{64}Ni′γ) and 236.1 *3* from ^{238}U(^{64}Ni,^{64}Ni′γ). I_γ: weighted average of 50 *20* from ^{208}Pb(^{64}Ni,^{64}Ni′γ) and 33 *14* from (^{238}U^{64}Ni,^{64}Ni′γ).
		688.9 *3*	9.5 *24*	3395.89	4$^+$			E_γ: note that a 688.9γ is placed from the 4268 level in ^{64}Co β^- decay.
		1474.9 *3*	100 *14*	2610.04	4$^+$	(E1)		E_γ,I_γ: other: 1474.8 *5* with Iγ=100 *20* from ^{208}Pb(^{64}Ni,^{64}Ni′γ). Mult.: D from γγ(θ) in ^{238}U(^{64}Ni,^{64}Ni′γ); (E1) from level scheme.
4172.53	6$^{(-)}$	323.4 *1*	100	3849.13	5$^-$	(M1)	0.00239	E_γ: other: 323.4 *2* from ^{208}Pb(^{64}Ni,^{64}Ni′γ). Mult.: D from γγ(θ) in ^{238}U(^{64}Ni,^{64}Ni′γ); most likely M1.
4174	(1,2)	4174[#]		0.0	0$^+$			
4216	4$^+$	1606[#]		2610.04	4$^+$			
4268.22	0$^+$	688.0 *3*	22 *9*	3578.66	(1$^+$)			E_γ,I_γ: from ^{64}Co β^- decay. Poor-fit; level-energy difference=689.56. Note that a 688.9γ is placed from 4085 level in ^{238}U(^{64}Ni,^{64}Ni′γ).
		1114.58[‡] *4*	100 *18*	3153.72	2$^+$			E_γ: from (n,γ) E=th. Other: 1114.6 *1* from ^{64}Co β^- decay. I_γ: from ^{64}Co β^- decay (0.30 s). Other: 100 *20* from (n,γ) E=th.
		2922.08 *9*	10.8 *11*	1345.777	2$^+$			E_γ: weighted average of 2922.1 *1* from ^{64}Co β^- decay (0.30 s) and 2922.07 *9* from (n,γ) E=th. I_γ: from (n,γ) E=th. Other: <21.7 from ^{64}Co β^- decay.
4346		1736[#]		2610.04	4$^+$			
4397		2120[#]		2276.58	2$^+$			
4417.6	(0$^+$ to 4$^+$)	2141.0 *3*	100	2276.58	2$^+$			
4453		2176[#]		2276.58	2$^+$			
4477.1	(6$^+$)	1311.3 *4*	100	3165.81	4$^+$			
4531.91	7$^-$	359.4 *1*	100	4172.53	6$^{(-)}$	(M1)	0.00186	E_γ: other: 359.4 *2* from ^{208}Pb(^{64}Ni,^{64}Ni′γ). Mult.: D or D+Q with ΔJ=1 from γγ(θ) in ^{238}U(^{64}Ni,^{64}Ni′γ); M1 is most likely.
4556.4	(0$^+$,1$^+$,2$^+$)	3210.5 *4*	100	1345.777	2$^+$			E_γ: from ^{64}Co β^- decay.
4573.16	2$^+$	1963[#]		2610.04	4$^+$			
		2297[#]		2276.58	2$^+$			
		3227.31[‡] *6*	100[‡] *5*	1345.777	2$^+$			
		4572.94[‡] *9*	49.8[‡] *25*	0.0	0$^+$			
4615.57	(1,2)	2339.17 *12*	75 *9*	2276.58	2$^+$			
		4615.27 *9*	100 *5*	0.0	0$^+$			

$^{64}_{28}Ni_{36}$-14

Adopted Levels, Gammas (continued)

γ(^{64}Ni) (continued)

E_i(level)	J_i^π	E_γ[†]	I_γ[†]	E_f	J_f^π	Mult.	α[&]	Comments
4640.66	2+	3294.90[‡] *7*	69.2[‡] *34*	1345.777	2+	[M1,E2]	0.00088 *6*	B(M1)(W.u.)=0.0097 *+4−5*; B(E2)(W.u.)=1.51 *8* B(M1)(W.u.) for pure M1; B(E2)(W.u.) for pure E2.
		4640.34[‡] *8*	100[‡] *5*	0.0	0+	[E2]	1.40×10^{-3}	B(E2)(W.u.)=0.394 *+13−16*
4704.12	0+	2427.50[‡] *9*	63[‡] *7*	2276.58	2+			
		3358.24[‡] *6*	100[‡] *5*	1345.777	2+			
4711.99	(6−)	626.8 *3*	27 *18*	4085.07	5(−)			
		862.9 *2*	100 *18*	3849.13	5−			
4719	4+	3373[#]		1345.777	2+			
4759	(1,2)	3413[#]		1345.777	2+			
		4759[#]		0.0	0+			
4868.54	(1,2)	3522.66[‡] *6*	100[‡] *5*	1345.777	2+			
		4868.34[‡] *11*	3.43[‡] *16*	0.0	0+			
4928		3582[#]		1345.777	2+			
4962.2	(6−,7−,8−)	430.3 *6*	100	4531.91	7−			
4963	(0+ to 4+)	3617[#]		1345.777	2+			
4991	2+	3645[#]		1345.777	2+			
5093	4+	696[#]		4397				
		3747[#]		1345.777	2+			
5155.56	(0+,1,2,3−)	2878.94[‡] *8*	83[‡] *9*	2276.58	2+			
		3809.64[‡] *9*	100[‡] *5*	1345.777	2+			
5215	4+	2938[#]		2276.58	2+			
		3869[#]		1345.777	2+			
5285	(2+,3,4+)	2675[#]		2610.04	4+			
		3939[#]		1345.777	2+			
5383	(0+ to 4+)	3106[#]		2276.58	2+			
		4037[#]		1345.777	2+			
5418.21	(1)−	4072.32[‡] *9*	100[‡] *5*	1345.777	2+			
		5417.92[‡] *12*	96[‡] *5*	0.0	0+			
5484	(3−)	3207[#]		2276.58	2+			
		4138[#]		1345.777	2+			
5735.8	(7−)	1204.1 *3*	100 *40*	4531.91	7−			
		1562.8 *4*	80 *40*	4172.53	6(−)			
5768.75	0+	3492.33[‡] *11*	82[‡] *4*	2276.58	2+			
		4422.60[‡] *10*	100[‡] *5*	1345.777	2+			

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Adopted Levels, Gammas (continued)

γ(^{64}Ni) (continued)

E_i(level)	J_i^π	E_γ[†]	I_γ[†]	E_f	J_f^π	Mult.	α[&]	Comments
5812.0	8^+	1280.1 *2*	100	4531.91	7^-	(E1)	1.71×10^{-4}	E_γ: weighted average of 1280.4 *5* from ^{208}Pb(^{64}Ni,^{64}Ni′γ) and 1280.0 *2* from ^{238}U(^{64}Ni,^{64}Ni′γ). Mult.: D or D+Q from γγ(θ) in ^{238}U(^{64}Ni,^{64}Ni′γ); E1 from level scheme.
6188.7	$9^{(-)}$	1656.8 *3*	100	4531.91	7^-	(E2)	2.33×10^{-4}	Mult.: Q from γγ(θ) in ^{238}U(^{64}Ni,^{64}Ni′γ); E2 is more likely.
6444	$(1,2)^+$	6444[#]		0.0	0^+			
6796.0	(10^+)	984.0 *4*	100	5812.0	8^+			
7020	(1,2)	7020[#]		0.0	0^+			
7220	(1,2)	7220[#]		0.0	0^+			
7730	(1,2)	7730[#]		0.0	0^+			
8240	(1,2)	8240[#]		0.0	0^+			

[†] From ^{238}U(^{64}Ni,^{64}Ni′γ), unless otherwise noted.

[‡] From (n,γ) E=th.

[#] γ from (p,p′γ) only, shown in the level scheme by 1969Be20, where the measured γ-ray energies were not listed. The energy here is deduced from level-energy difference. This value is considered as approximate and may deviate by as much as 15 keV from that quoted in (p,p′γ) dataset.

[@] 2020Ma37 in (n,γ) E=th states that γγ(θ) of the cascade toward 1346 level indicates a dominant M1 character, with only a small E2 admixture.

[&] Total theoretical internal conversion coefficients, calculated using the BrIcc code (2008Ki07) with Frozen orbital approximation based on γ-ray energies, assigned multipolarities, and mixing ratios, unless otherwise specified.

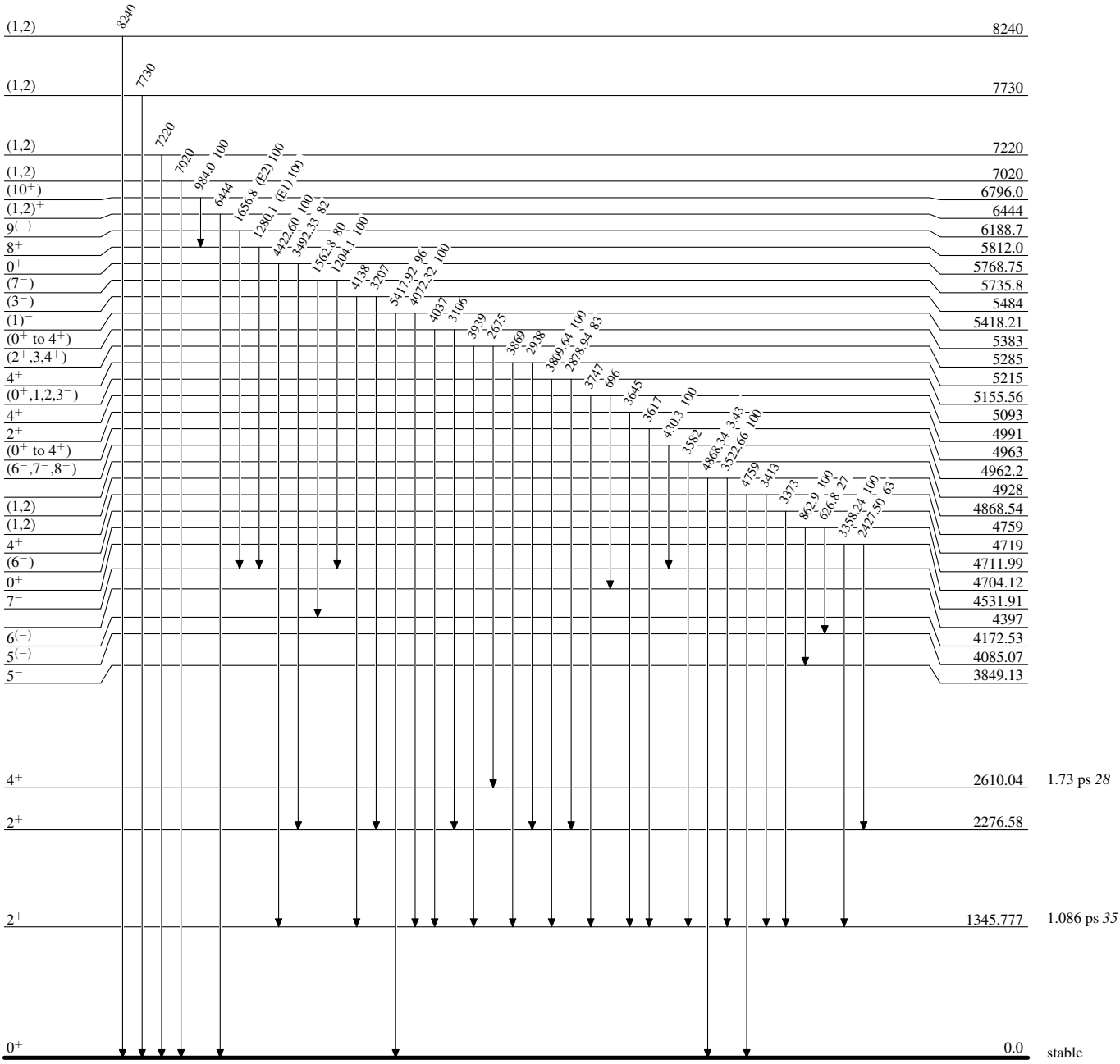
[a] Placement of transition in the level scheme is uncertain.

$^{64}_{28}Ni_{36}$-16

Adopted Levels, Gammas

Level Scheme

Intensities: Relative photon branching from each level



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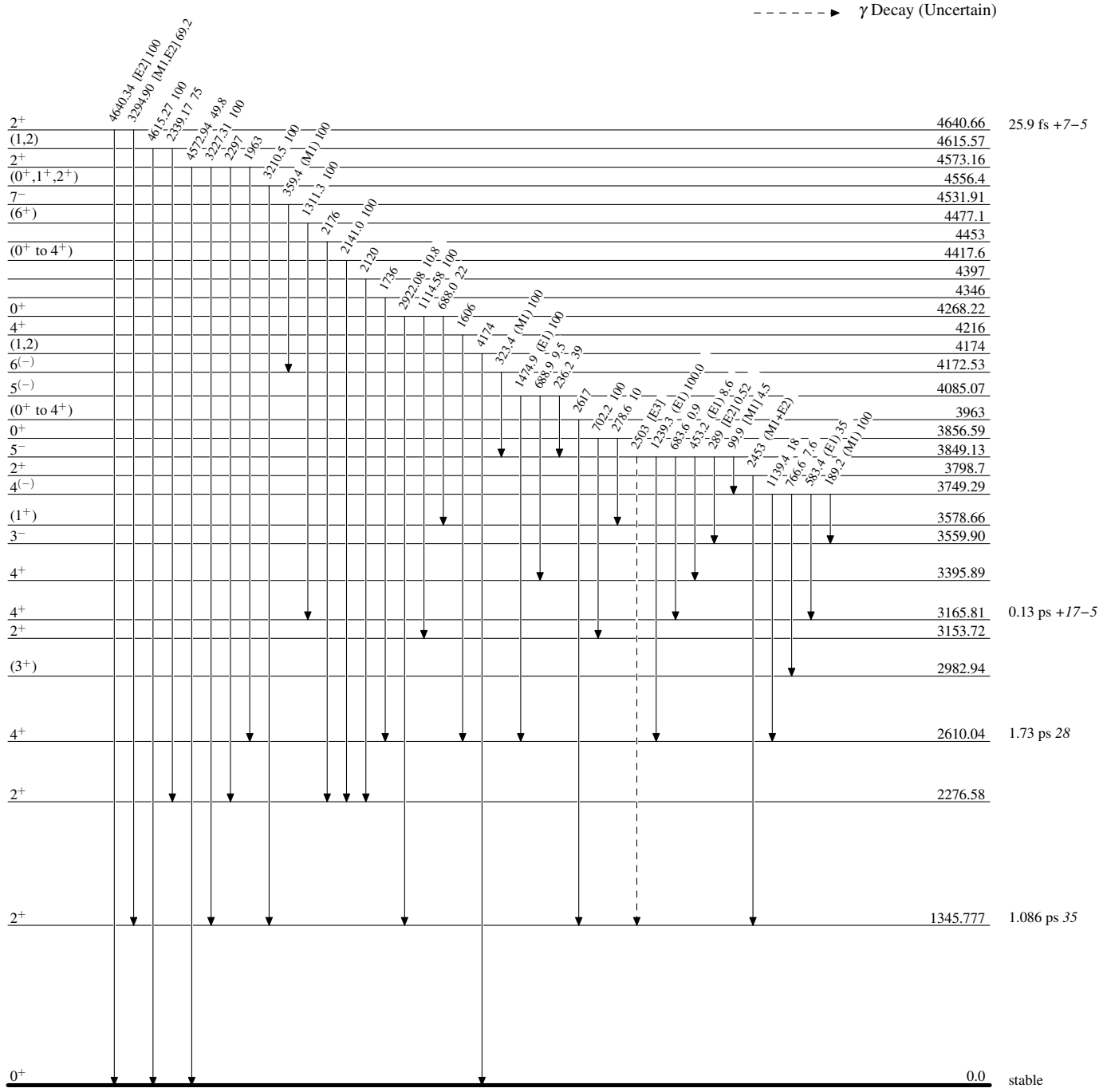
Adopted Levels, Gammas

Legend

Level Scheme (continued)

Intensities: Relative photon branching from each level

– – – – – – ► γ Decay (Uncertain)



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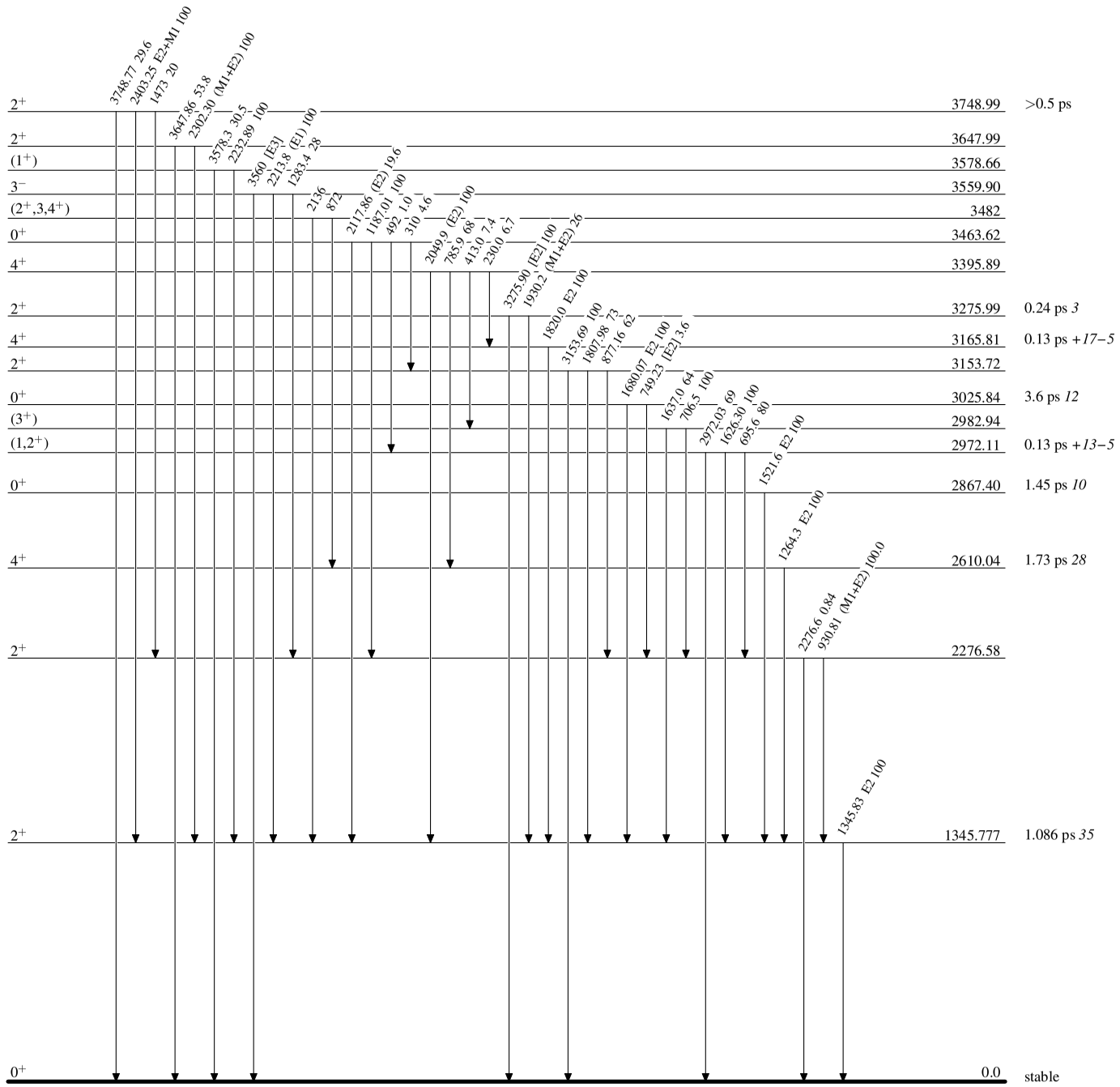
Adopted Levels, Gammas

Level Scheme (continued)

Intensities: Relative photon branching from each level



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